Preequilibrium Reactions with Complex Particle Channels

Constance Kalbach (Walker)

Triangle Universities Nuclear Laboratory and Duke University

Since the field of preequilibrium reaction studies was launched in 1966 by the seminal paper of J. J. Griffin, much progress has been made in understanding these reactions and in improving the predictive ability of model calculations. Yet most of the work considers only reactions with nucleons as both the incoming and outgoing particles. This paper describes efforts to improve the 1985 phenomenological description of reactions with deuterons, tritons, He-3 ions, or alpha particles in the entrance and/or exit channel. It utilizes new literature data and incorporates advances in the exciton model for reactions involving only nucleon channels. Interim results were incorporated in the code PRECO-2000.

Complex particle channels are difficult to treat because of the variety of reaction mechanisms that contribute. The mechanisms considered in PRECO are (1) emission during equilibration that is described by the exciton model, (2) direct transfer of one or more nucleons, (3) knockout and inelastic scattering involving cluster degrees of freedom, and (4) excitation of collective states (both spectroscopic and giant resonance). In addition, a preliminary formulation for complex particle breakup has been developed for incident deuterons. It will be included in the code after being extended to He-3 and alpha projectiles and after angular distributions have been considered.

This paper describes the current status of the models and presents comparisons with some of the many inclusive energy spectra studied. The data involve reactions at incident energies up to 63 MeV for neutrons, 90 MeV for protons, 80 MeV for deuterons, 41 MeV for He-3, and 140 MeV for alpha particles. The current models provide a significant improvement in predictive ability over earlier versions and will all be included in the next release of PRECO.

Email: cwalker@tunl.duke.edu